

The second operation unit 55 divides the value Va calculated by the butterfly operation at the final stage of the predetermined number of stages n by the final scale factor Sfn , and then outputs the result.

The division and multiplication selection unit 51 calculates a difference value L between the predetermined number of stages n and the scale count Sc , and determines the selection signal D whether it is for the division operation or the multiplication operation, and then outputs the difference value L and the selection signal D .

The coefficient calculation unit 53 calculates the coefficient R required for compensating the input bit signal from the difference value L .

The division and multiplication calculation unit 57 selectively performs the division operation and the multiplication operation on the value Si from the second operation unit 55 according to the selection signal D , and then yields a result value So .

The bit compensation unit 58 receives the coefficient R from the coefficient calculation unit 53, the selection signal D and the value So , and compensates for the value So according to the coefficient R and the selection signal D , resulting in the compensated value t .

The adder unit 59 adds the compensated value t (input from the bit compensation unit 58), and then outputs the result.

The second operation unit 55 divides the bit value Va of the butterfly operated signal at the final stage of the predetermined number of stages n by

the scale factor **Sfn** calculated at the final stage, and then outputs the result value **Si=Va/Sfn**.

The division and multiplication selection unit 51 compares the predetermined number of stages **n** with the output value **Sc** from the scale count unit 41 to yield the difference value **L**, by the following arithmetic expression:

$$L = |Sc - n| \quad (2)$$

The division and multiplication selection unit 51 also yields and outputs a selection signal **D** for determining between the division operation and the multiplication operation. If the predetermined number of stages **n** is greater than **Sc**, then the selection signal is set for the division operation, while if the scale count **Sc** is greater than **n**, then the selection signal is set for the multiplication operation.

The coefficient calculation unit 53 calculates and outputs a quotient **Q** and remainder **R** by dividing the difference value **L** from the division and multiplication selection unit 51 by 2 as the following arithmetic expression:

$$L/2 = 2Q + R \quad (3)$$

The division and multiplication calculation unit 57 calculates and outputs the multiplication result **So** obtained by multiplying the value input from the second operation unit by 2^Q if the selection signal is for the multiplication operation, while the division and multiplication calculation unit 57 calculates and outputs the division result **So** obtained by dividing the value

input from the second operation unit by 2^Q if the selection signal is for the division operation by the following arithmetic expressions:

$$S_o = S_i \times 1/2^Q \text{ (if } D = D_2) \quad (4)$$

$$S_o = S_i \times 2^Q \text{ (if } D = D_2) \quad (4)$$

5 The bit compensation unit 58 outputs the data S_o intact from the division and the multiplication unit 57 to the adder unit 59 if the remainder R of the expression 3 is not “1”

10 The bit compensation unit 58 calculates and outputs the multiplication results $t1=t11, t12, t13, t14$ to the adder unit 59 after multiplying the data S_o from the division and the multiplication calculation unit 57 by $1/2, 1/8, 1/16, 1/64$, respectively, if the remainder R of the expression 3 is “1” and if the selection signal input is for the division operation $D1$, which can be expressed by the following arithmetic expressions:

$$\begin{aligned} t11 &= S_o \times 1/2 \\ t12 &= S_o \times 1/8 \\ t13 &= S_o \times 1/16 \\ t14 &= S_o \times 1/64 \end{aligned} \quad (5)$$

20 Alternately, the bit compensation unit 58 calculates and outputs the multiplication results $t2=t21, t22, t23, t24$ by multiplying the data S_o from the division and the multiplication calculation unit 57 by $1, 1/4, 1/8, 1/32$, respectively, if the remainder R of the expression 3 is “1” and if the selection signal input is for the multiplication operation $D2$, which can be expressed by the following arithmetic expressions: